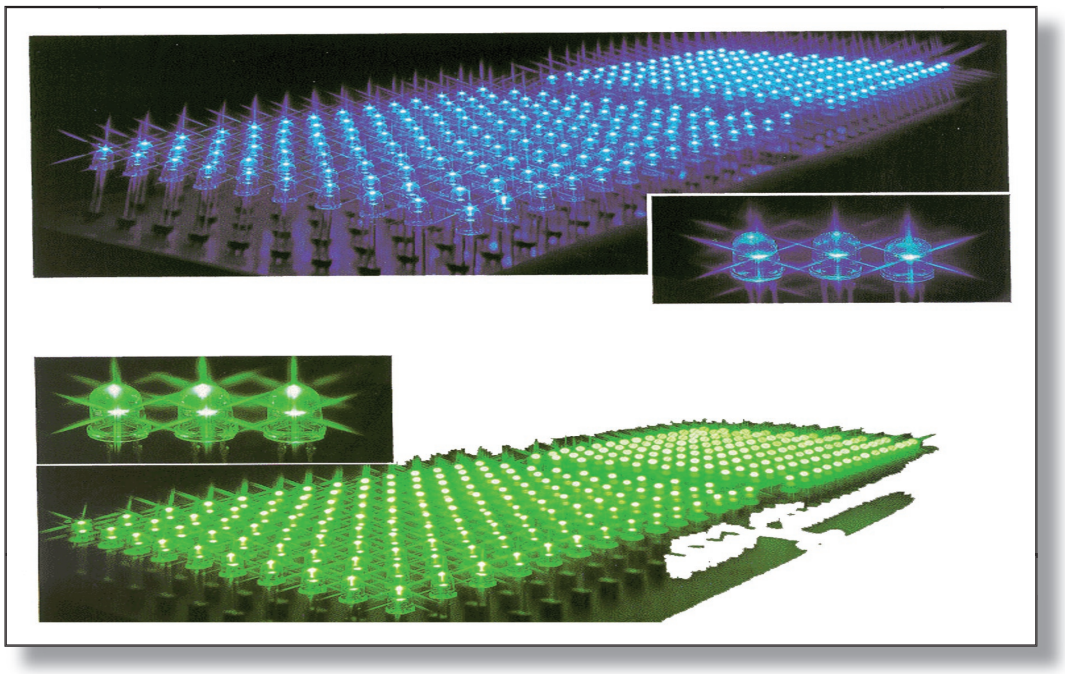
Air Force Research Laboratory|AFRL

Science and Technology for Tomorrow's Air and Space Force

Success Story

BREAKTHROUGHS IN GROUP III-NITRIDES



Group III-Nitrides, such as gallium nitride (GaN), are promising candidates for a variety of AF applications. They possess excellent physical and electrical properties to operate in harsh environments. Scientists predict that devices based on GaN materials will have numerous Air Force and Department of Defense applications and an enormous impact on high-power radars such as those employed on remote-sensing platforms. Other applications include displays and indicators based on light-emitting diodes, laser diodes for optical data storage, and sensor and detector surveillance systems.

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Accomplishment

Important research and significant advances by Air Force Office of Scientific Research (AFOSR)-funded scientists are attracting worldwide attention in the area of semiconductors. Several institutes in Korea and Japan, working in conjunction with the Materials and Manufacturing Directorate, are conducting semiconductor research in Group III-Nitrides such as GaN.

Background

Due to a widespread increase in Asian research in the area of nitride semiconductors, the Asian Office of Aerospace Research and Development sponsored initiatives with several institutions in Asia to address efficient device performance. AFOSR managers capitalized on tapping into the burgeoning field, especially in Korea and Taiwan, largely because of the astounding achievements of a single researcher, Dr. Shuji Nakamura, the world's foremost expert in nitrides. Dr. Nakamura, formerly of Japan, is a professor at the University of California at Santa Barbara (UCSB).

While Dr. Nakamura was the first to successfully establish the means for growing crystalline GaN layers for devices, many characteristics of nitrides remain unclear. This is because the world lacks a viable GaN substrate upon which to grow high-quality crystal lattice-matched structures and subsequently fabricate high-performance devices.

Korea's Samsung Advanced Institute of Technology found an effective alternative substrate or template upon which to grow good material. These lattice-matched structures characterize and optimize important material system parameters and allow AFRL researchers to understand and thereby minimize the performance-limiting defects that plague these materials.

Other improved nitride material projects involve collaborations between Japanese researchers at Tsukuba University and UCSB Professors Steven DenBaars and Shuji Nakamura. Since 1996, this US-Japan team worked together to champion the basic physics and preparation of GaN crystal layers.

Another effort to understand and ultimately to control defects is the collaboration between Science University of Tokyo (Ohkawa) and UCSB (Dr. Nakamura). This partnership establishes the interfacial physics involved in the chemistry of nitrides, particularly how nitrides behave in chemical reactions.

Office of Scientific Research
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Additional information

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